



ATTAM/EOA Steering Committee Update

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NASA Aeronautics – Vision for Aviation in the 21st Century



Global

Sustainable

Transformative

ARMD continues to evolve and execute the Aeronautics Strategy
<https://www.nasa.gov/aeroresearch/strategy>

6 Strategic Thrusts



Safe, Efficient Growth in Global Operations



Safe, Quiet, and Affordable Vertical Lift Air Vehicles



Innovation in Commercial Supersonic Aircraft



In-Time System-Wide Safety Assurance



Ultra-Efficient Subsonic Transports



Assured Autonomy for Aviation Transformation




Research Programs Align with Strategic Thrusts




MISSION PROGRAMS

Airspace Operations & Safety (AOSP)

PROJECTS




Advanced Air Mobility
Advanced Capabilities for Emergency Response Operations
ATM-X
System-Wide Safety




Advanced Air Vehicles Program (AAVP)

PROJECTS




Advanced Air Transport Technology
Hybrid Thermally Efficient Core
Hi-Rate Composite Aircraft Manufacturing
Commercial Supersonic Technology
Revolutionary Vertical Lift Technology
Hypersonic Technology




Integrated Aviation Systems Program (IASP)

PROJECTS



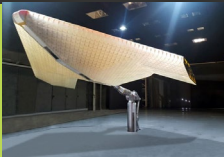
Electrified Powertrain Flight Demonstration
Flight Demonstrations and Capabilities
Low Boom Flight Demonstrator
Sustainable Flight Demonstrator


Integration & Flight


SEEDLING PROGRAM

Transformative Aeronautics Concepts Program (TACP)

PROJECTS



Convergent Aeronautics Solutions
Transformational Tools & Technologies
University Innovation



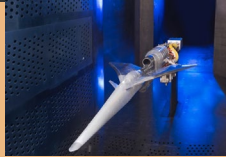
PORTFOLIO OFFICE


Aerosciences Evaluation and Test Capabilities (AETC)

GROUND FACILITIES

Subsonic
Transonic
Supersonic

Hypersonic
Propulsion
Test Technology







Thrust 2: Innovation in Commercial Supersonic Aircraft



High-Speed Commercial Flight

Sustainable transformation of the speed of air travel



Addressing the unique barriers to sustainable, environmentally responsible high-speed flight

The Quesst Mission generates key data to support development of en route certification standards based on acceptable sound levels

X-59 Construction and Testing



Complete X-59 Build in Fall 2022
Achieve First Flight in 2023

Quesst Mission Overview

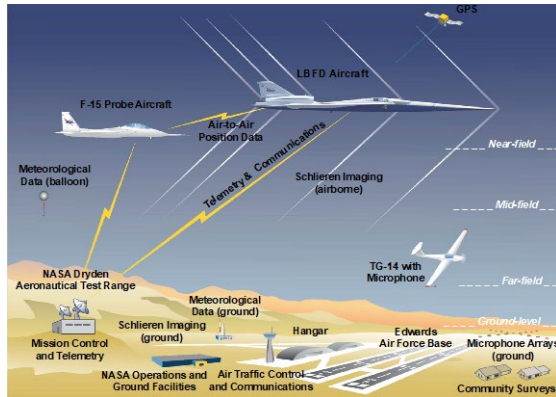


QUESST

Phase 1 – Aircraft Development

In progress (FY18-23)

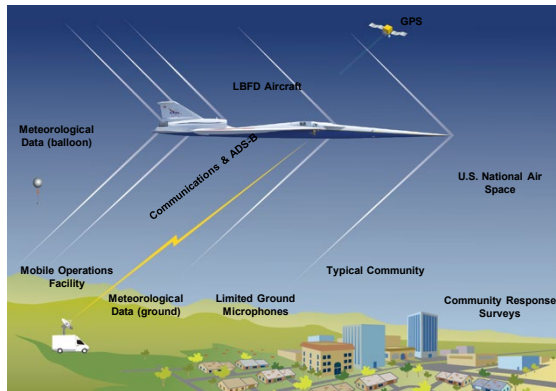
- Design, fabricate a quiet supersonic research aircraft
- Prove performance in test range flights
- Prove safety for flights in normal airspace



Phase 2 – Acoustic Validation

Preparation in progress (FY18-23), Execution 2024

- Prove the acoustic characteristics match design targets
- Detailed in-flight and ground measurements in test range



Phase 3 – Community Response Testing

Preparation in progress (FY19-23), Execution 2025-27

- Conduct community tests
 - Select communities
 - Outreach and engagement (including STEM)
 - Obtain necessary approval
 - Plan surveys and recruit participants
 - Collect ground measurements

**Systematic
Approach Leading
to Community
Testing**

Acoustic Validation & Community Response Testing Preparations



*Site selection process developed,
and survey plan baselined*



*V&V-driven design update for
production Ground Recording
System units*

*GRS prototype deployed during
CarpetDIEM2 test*

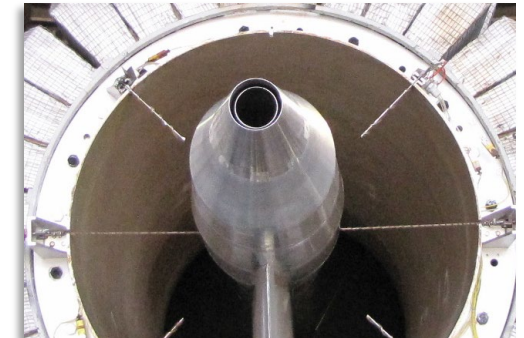
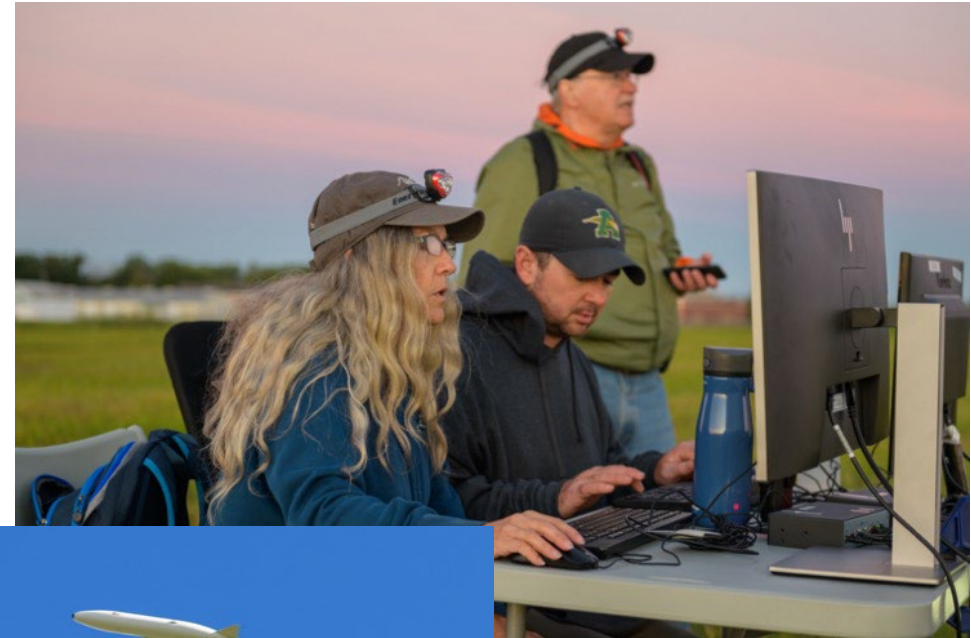


Test planning & hardware development
are making significant progress toward readiness

Landing and Takeoff Noise



Acoustic data from flight and rig tests will improve noise predictions used in studies of environmental impact of future supersonic aircraft.



Quantifying the impact of future aircraft on airport noise.



Thrust 3: Ultra-Efficient Subsonic Transports



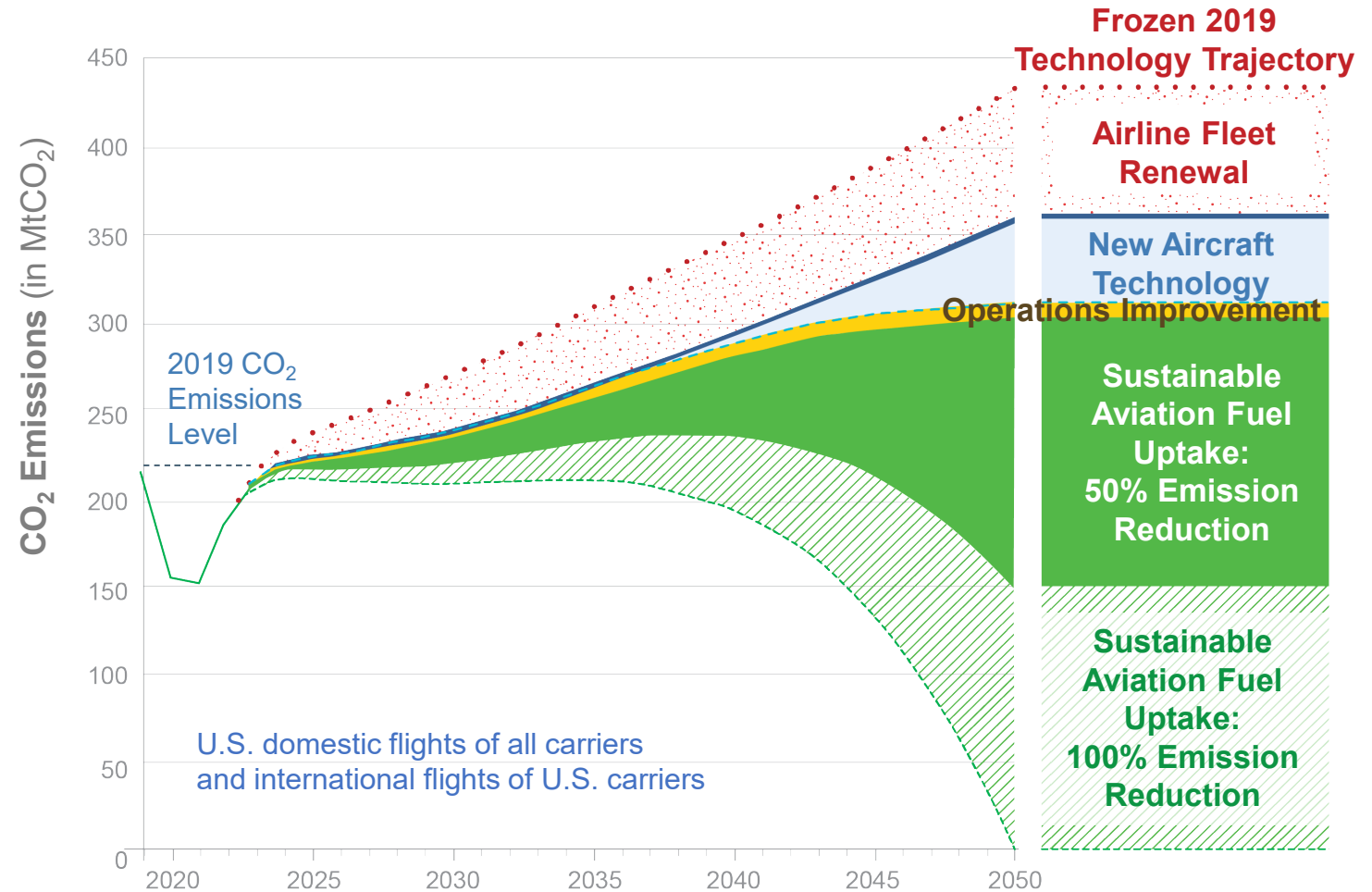
U.S. Aviation Climate Action Plan

Global Context for Sustainable Aviation

U.S. aviation goal is to achieve **net-zero greenhouse gas emissions by 2050.**

U.S. Aviation Climate Action Plan is aligned with

- U.S. economy-wide goal
- International Civil Aviation Organization
- Air Transport Action Group



https://www.faa.gov/sites/faa.gov/files/2021-11/Aviation_Climate_Action_Plan.pdf

The U.S. is working with the global community to achieve net-zero greenhouse gas emissions by 2050 using a common basket of measures.



Aviation Pillars for a Sustainable Future

Global Aviation GOAL: net-zero carbon emissions by 2050

TECHNOLOGY



NASA = Primary Role

SUSTAINABLE
AVIATION FUEL



NASA = Supporting Role

OPERATIONS
AND INFRASTRUCTURE



NASA = Primary Role

Sustainable Flight National Partnership Benefits



Small Core Gas Turbine for
5%-10% fuel burn benefit
(HyTEC Project)

Electrified Aircraft Propulsion
for ~5% fuel burn and
maintenance benefit
(EPFD & AATT Projects)

Sustainable Aviation Fuels for
reduced lifecycle carbon
emissions
(AATT Project)

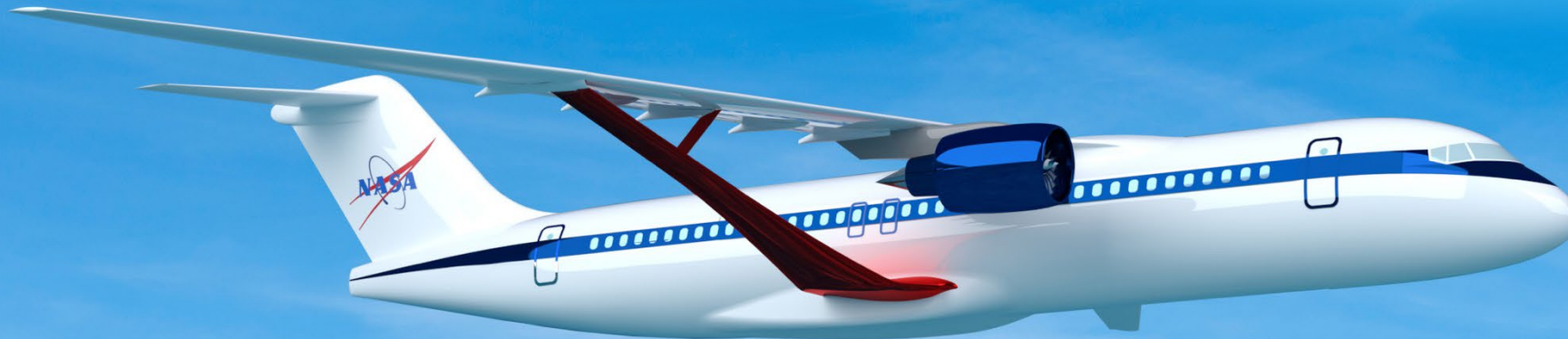
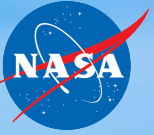
Transonic Truss-Braced Wing for
5%-10% fuel burn benefit
(SFD & AATT Projects)

High-Rate Composites for
4-6x manufacturing
rate increase
(HiCAM Project)

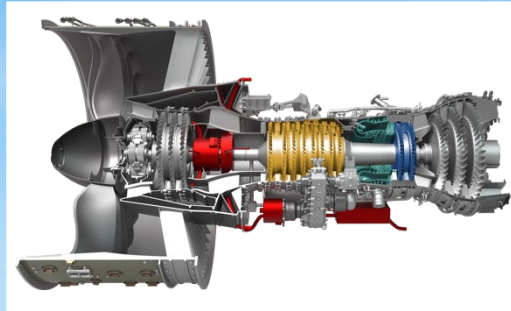
Integrated Trajectory Optimization for
1%-2% reduction in fuel required
and minimization of contrail
formation
(ATM-X Project)

Subsonic Transport Technologies

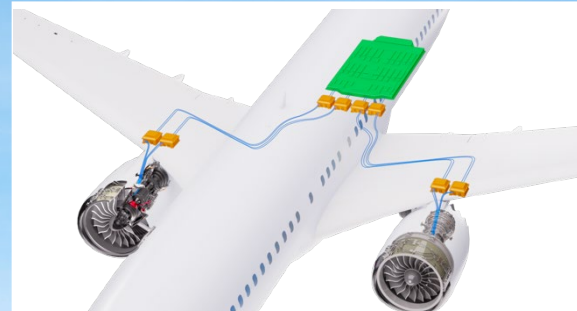
Ensure U.S. industry is the first to establish the new “S Curve” for the next 50 years of transports



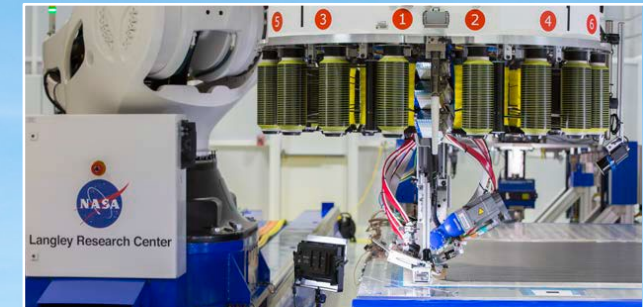
Transonic Truss-Braced Wing
5-10% fuel burn benefit



Small Core Gas Turbine
5-10% fuel burn benefit

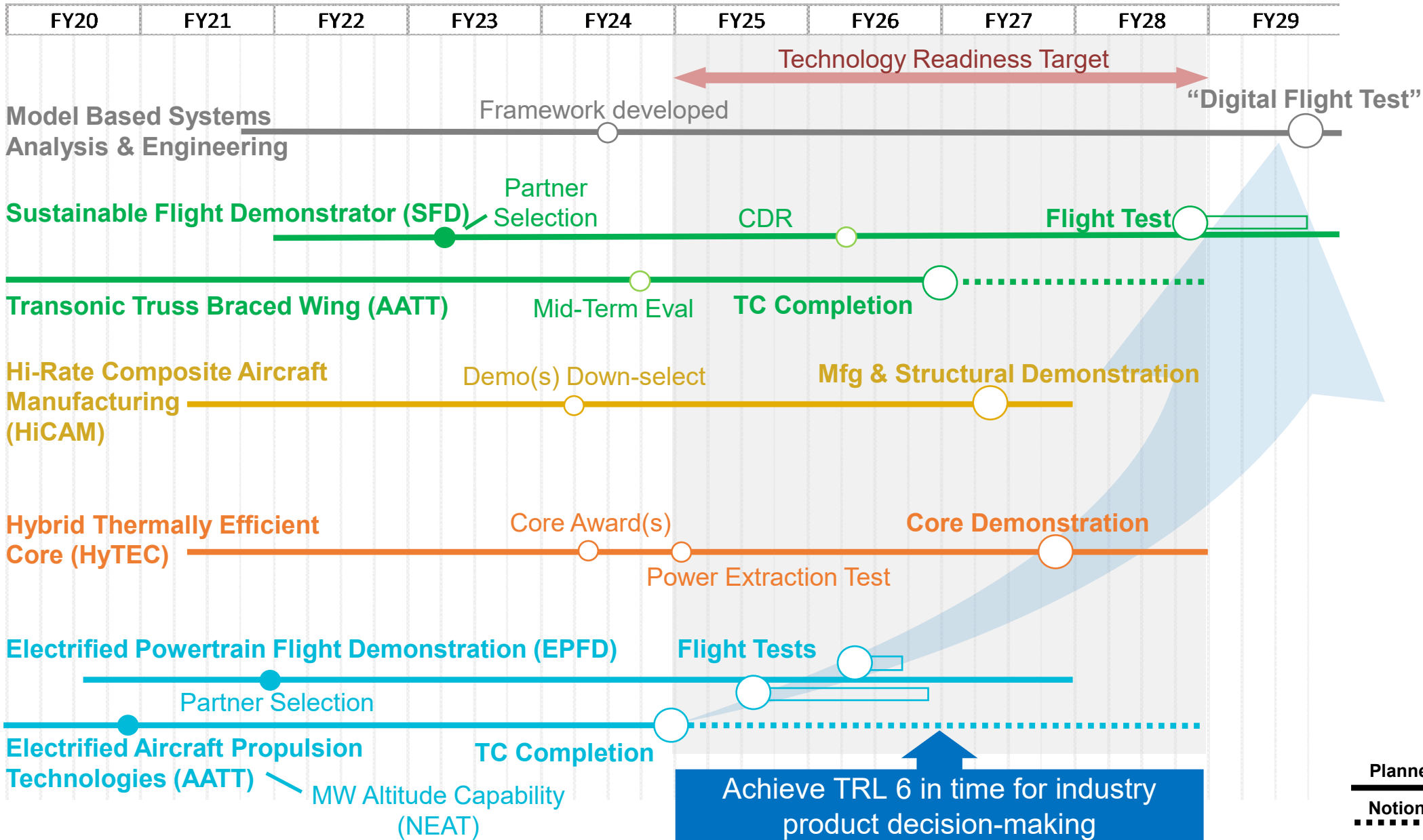
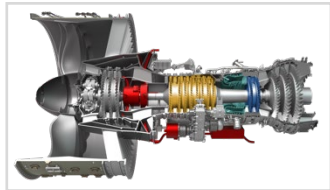
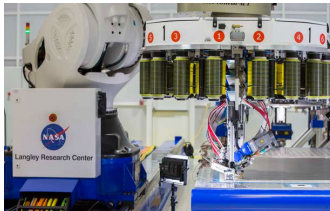


Electrified Aircraft Propulsion ~5%
fuel burn and maintenance benefit



High-Rate Composite Manufacturing
4-6x manufacturing rate increase

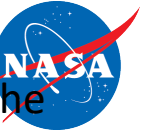
Subsonic Transports: Integrated Technology Development





Thrust 4: Safe, Quiet, & Affordable Vertical Lift Air Vehicles

RVLT Provides Tools & Design Practices for UAM eVTOL Vehicles



Thrust 4 Critical Commitment (4.1): Deliver validated tools and recommended practices for **noise and safety** that support the ability to certify and safely operate advanced urban-capable VTOL vehicles in a medium density operational environment.

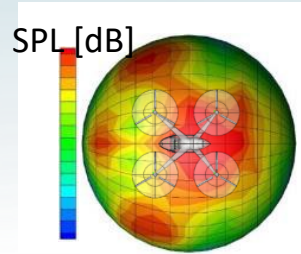
Noise Research



Human Response to UAM Noise



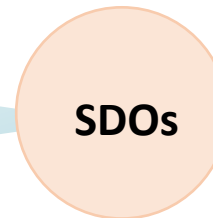
UAM Acoustic Impacts



Predictive Tools for UAM Noise



Share technical insights and lessons learned



Safety Research



Crashworthiness & Occupant Protection



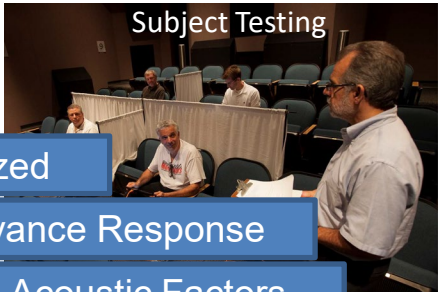
Handling Qualities



Electric Powertrain Reliability

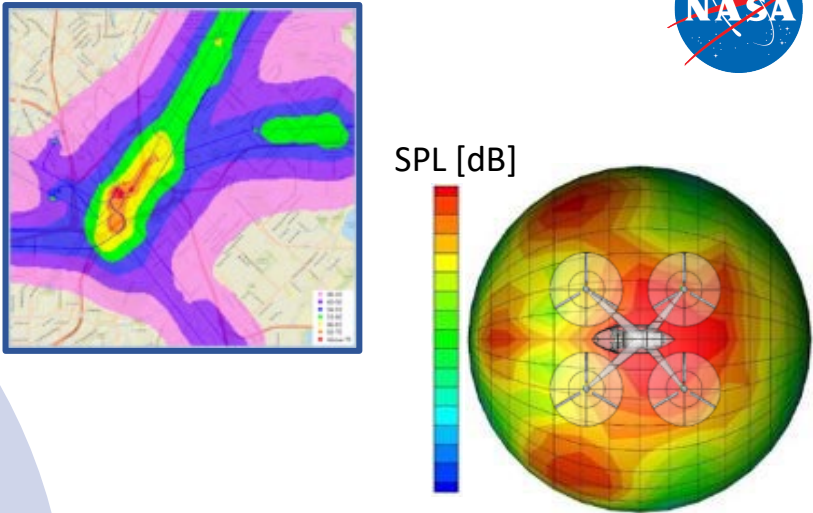
Inform eVTOL Systems Standards and Certification

RVLT UAM Noise Research Approach



Psychoacoustic Research for Human Response to UAM Noise

Develop and Distribute Noise Prediction Tools



Accurately Model and Predict UAM Noise Sources



Obtain Flight and Wind Tunnel Data to Characterize Noise

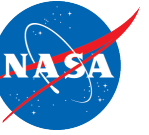
Methods for Assessing UAM Acoustic Impact in Operations



Photo Credit: Joby Aviation

Provide Design Tools and Guidelines for Low Noise Design and Operations

RVLT UAM Safety Research Approach



Develop Assessment Tools
and Guidelines for UAM
Modeling

Use Unique Facilities to
Generate Data and Assess
New Concepts

Transfer Tools and Data to
Regulators, Standards
Development Organizations,
and User Community

Propulsion: reliability of
motors, fault-tolerance,
electrical system standards

Handling and Ride Qualities:
vehicle response, control
system authority, passenger
response to motion

Crashworthiness: occupant
protection, safety after
impact



Magnetic Gear
Motor Prototype



Simulated Operation for
Handling Quality Evaluation



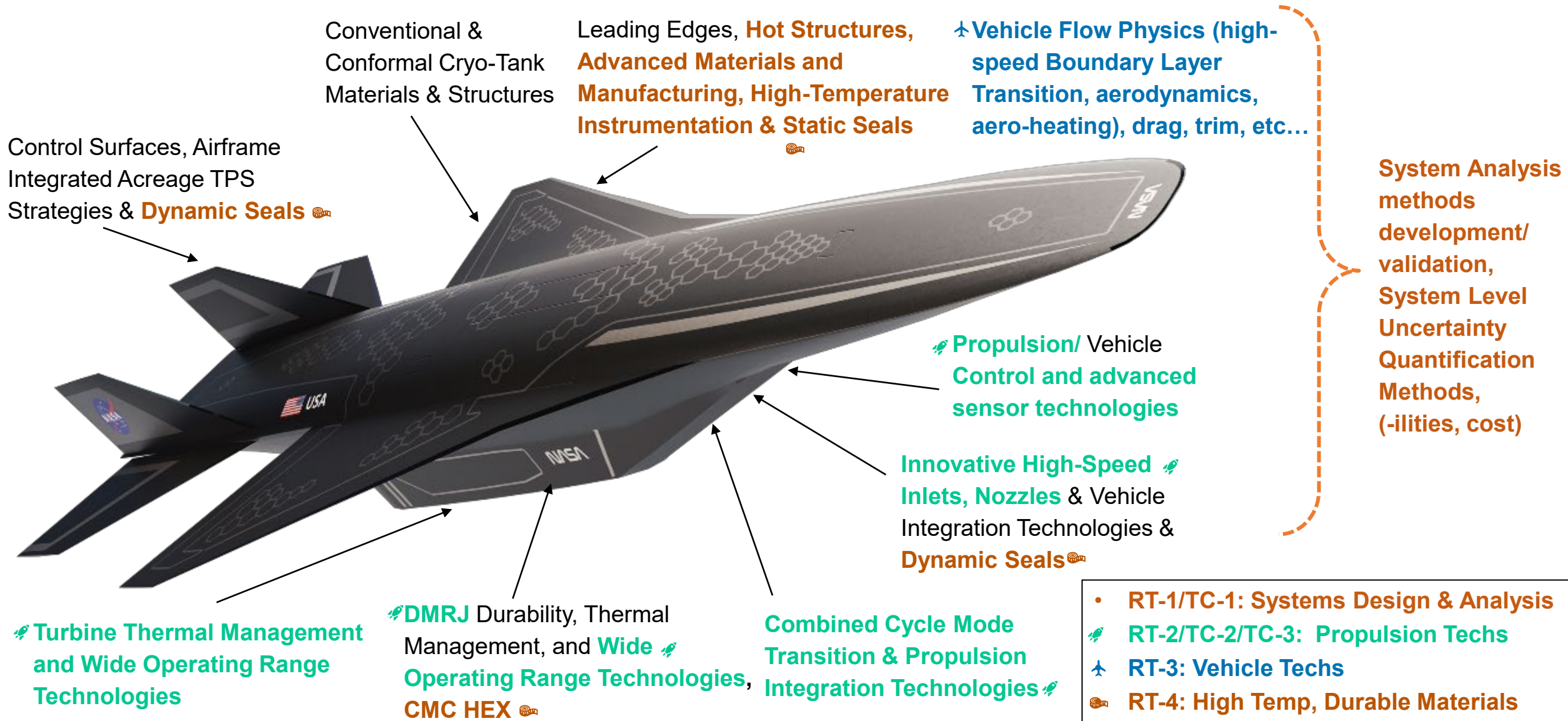
Evaluation of Seats,
Subfloor, and
Occupant Loads
during Impact

Provide Design Tools and Guidelines for Safe, Reliable Operations and Standards



Hypersonics

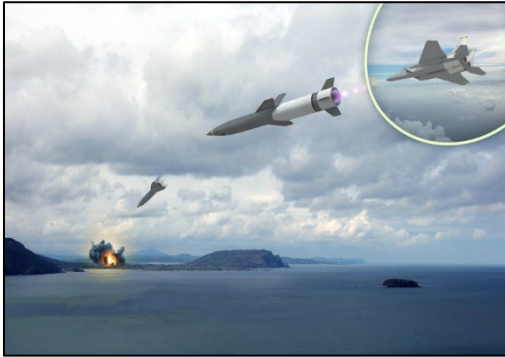
Common Barriers to Air Breathing Reusable Hypersonic Flight



NASA-DoD Major Collaborations



Hypersonic Airbreathing Weapon Concept (HAWC) USAF-DARPA



- SME support including Airframe IPT lead
- System analysis
- Aero and propulsion analysis ground testing

Advanced Full Range Engine (AFRE) DARPA



- SME support including Propulsion IPT leads
- System studies
- Mode transition design, analysis & testing
- Propulsion testing



HIFIRE-2C AFRL

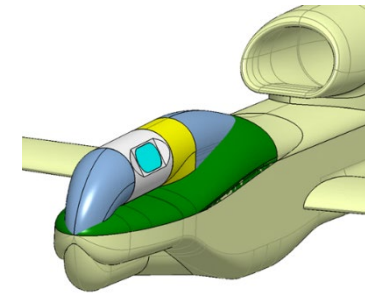
- Joint NASA-AFRL project
- SME support including CE, Co-PI, S&A and ModSim IPT Leads
- Propulsion testing
- CFD

Tactical Boost Glide (TBG) USAF-DARPA



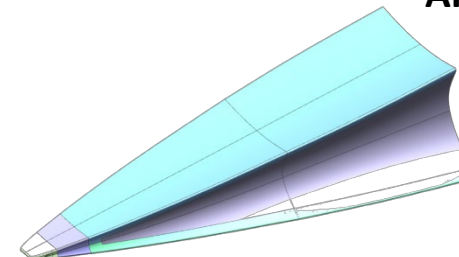
- SME support including Materials IPT lead
- High temp materials analysis, test & database
- Aero/Aerothermal analysis & test

RangeHawk Technology Demonstrations TRMC



- Imaging Instrumentation
- Development and ground test
- Global Hawk Integration
- Flight testing
- Capability Transition Planning

Boundary Layer Transition (BOLT/BOLT2) AFRL-AFOSR



- Testing – ground & launch services
- CFD
- Co-Principal Investigator

NASA's Role in Emerging Commercial High-Speed Market



3 Govt/Industry Workshops held 2020-2022



February 2021- Virtual



Industry Feedback On Opportunities/Needs:

- Independent market study
- Hypersonic ground and flight test capability
- Technology development through collaborative agreements
- Regulatory concerns
- International partnerships
- Data protection concerns (export control, classified, CUI, etc.)
- Integration into NAS

Opportunities encompass multiple ARMD Programs/Projects

Emerging Commercial High Speed Market Key Takeaways



- **Many key barriers for commercial supersonic and hypersonic flight appear to be similar**
 - Significant differences resulting from differences in Mach and associated flight conditions
- **Industry feedback from 3rd High-Speed Commercial Vehicle Workshop (June 2022) reinforces the need for conceptual vehicle studies to assess these barriers and potential solutions in the $2 < M < 5$ range**
- **Contracts awarded Jan 2023 to:**
 - Develop conceptual government reference high-speed vehicle designs
 - Identify the critical technologies that will address the key barriers
 - Develop technology roadmaps that can be used to frame new technical challenges either in CST and/or HTP
- **Non-proprietary concepts will be key for use in regulatory studies**



Image Credit: Lockheed Martin

Legacy Supersonic N+2/N+3
Conceptual Designs



Image Credit: The Boeing Company

High-Speed Investment Opportunities to be Reported at 2024 SPMR



Wrap-up

A New Era of Flight is Emerging



Breaking down barriers to open new markets, advance U.S. competitiveness, and make air travel better for all Americans and for people around the world.

Next Generation Subsonic Transports

Making commercial air travel more sustainable

Advanced Air Mobility

Allowing people to move about more easily

Commercial Supersonic Flight

Addressing environmental barriers to connect people faster

Hypersonic Flight

Enabling a future vision for hypersonic transport

